Regional Sediment Management

Southeast Oahu Regional Sediment Management: Identifying Sediment Pathways in the Vicinity of Wailea Point

Improved Characterization and Estimates of Sediment Sources, Pathways, and Sinks under the System-Wide Water Resources Program (SWWRP)

New Program Manager

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Regional Sediment Management

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James R. Houston, Ph.D.
Director

About the Cover

Southeast O'ahu Regional Sediment Management (SEO/RSM) study area extends along approximately 12 miles of shoreline from Mokapu (taboo) Point to the north and Mokapu'u (hilltop) to the south. Towns within the region include Kailua (whole in the sea), Lanikai (sky and sea) and Waimanalo (sweet water). Military installations within the area are Marine Corps Base Hawaii and Bellow Air Force Station (AFS).

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Southeast Oahu Regional Sediment Management: Identifying Sediment Pathways in the Vicinity of Wailea Point

by Thomas D. Smith and Jessica R. Hays, U.S. Army Engineer District, Honolulu

Initial regional sediment management efforts in Hawaii have been focused along the southeast O'ahu (Hawaiian for the gathering place) coast. The Southeast O'ahu Regional Sediment Management (SEO/RSM) study area extends along approximately 12 miles of shoreline from Mokapu (taboo) Point to the north and Mokapu'u (hilltop) to the south. Towns within the region include Kailua (whole in the sea), Lanikai (sky and sea) and Waimanalo (sweet water). Military installations within the area are Marine Corps Base Hawaii and Bellow Air Force Station (AFS). The region experiences prevailing trade winds from the northeast, associated trade showers, and locally generated wind waves. A broad shallow nearshore reef extends along the length of the region. The reef is nominally 2,000 feet wide and has an average depth of about 4 feet. Small offshore islets such as Manana (buoyant), Kaohikaipu (hold back breaking waves), Na Mokulua (calmed, two adjacent islands), Popoi'a, and Mokolea (filled with water) Rock are scattered throughout the reef flat.

Generally, wide sand beaches are a rare sight in Hawaii, but within the SEO region there are a number of long stretches of pristine kahaone (sandy beach). These areas include numerous State of Hawaii-owned beach parks and portions of Bellow AFS. Beach sand in the region primarily comprises calcium carbonate grains derived from shells, corals, and other aquatic organisms. Basalt from the eroding island mountains can also be found in sand samples taken within the active beach profile. At the northern limit of the region, significant quantities of olivine are also present along the upper reaches of the beach.

This is not to say the region does not have erosion and sediment management issues. At Ka'elepulu (hollow and wet) stream mouth, sand from the adjacent shorelines accumulates and blocks the flow of water from Enchanted Lake upstream. The existing sediment management practice is to periodically excavate the sand from the mouth of the stream and place it along the adjacent streambanks. Not only does this practice take the material out of the active profile, strong trade winds blow the sand mauka (toward the mountain) and out of the system. On either side of Wailae (happy water) Point, coastal structures have been constructed such as seawalls, groins, revetments and jetties. Beaches in these areas (including portions of both Lanikai and Bellows AFS) are narrow to nonexistent. At the southern end of the region, the shoreline is eroding and currently within a few feet of Kalanianna'ole Highway along Kaupo (a variety of native banana) and Kaiona (sea mite) beaches. The highway is a major transit route and provides the only access to much of the windward O'ahu coastal margin. The scarcity

of beach quality sand and environmental concerns in Hawaii limit the opportunities for beach nourishment.

A major goal of the SEO/RSM study is to quantify the movement of sand offshore of Wailea (happy waters) Point. The point is located in the central portion of the region and divides the town of Lanikai to the north and Bellows AFS to the south. At the present, the portion of Lanikai beach located adjacent to Wailea Point is awash at high tide and a continuous series of seawalls has been built to protect oceanfront singe-family homes. Further to the north, the beach widens significantly until one reaches Alala (a variety of sweet potato) Point. Beyond Alala Point, the beaches of Kailua are from 100 feet to 200 feet wide and the oceanfront houses are set back up to 300 feet from the mean high water shoreline.

Similarly, south of the point the shoreline has been armored through construction of a revetment along approximately 2,000 feet of the Bellows AFS shoreline. A 50-foot-long groin has been constructed at the point which retains a small pocket beach in front of an officer's beach cottage rental unit. Jetties have also been constructed at the mouth of Waimanalo stream in an attempt to keep the mouth of the stream from being plugged by the influx of sand from adjacent beaches. In order to quantify sediment transport in the vicinity of Wailea Point, the SEO/RMS study strives to incorporate multiple assessment techniques to attain an understanding of the regional coastal processes at work, assess anthropogenic impacts to the system and develop a sediment budget for the area and ultimately the entire region.

In pursuit of a regional sediment budget for SEO, wave, current, and sediment data have been collected, a wave transformation model has been coupled to a water circulation model, and a historical shoreline change analysis is underway. Field data collection was conducted for a one month period in the fall of 2005. Data collection consisted of deployment of Acoustic Doppler Current Profilers (ADCP) and currents) and Acoustic Doppler Velocimeters (ADV) gauges and the tracking of drogues following their release at various locations within Kailua and Waimanalo bays. Instrument locations are shown in Figure 1. Deployment was on 9 Aug 2005 and retrieval was on 14 Sep 2005. Each gauge successfully collected a minimum of one month of time series data.

The ADCP gauges were RD Instruments 1,200 kilohertz Workhorse, bottom mounted facing upward with the sensor head approximately 0.4 meters off the bottom. Figure 2 shows the custom built

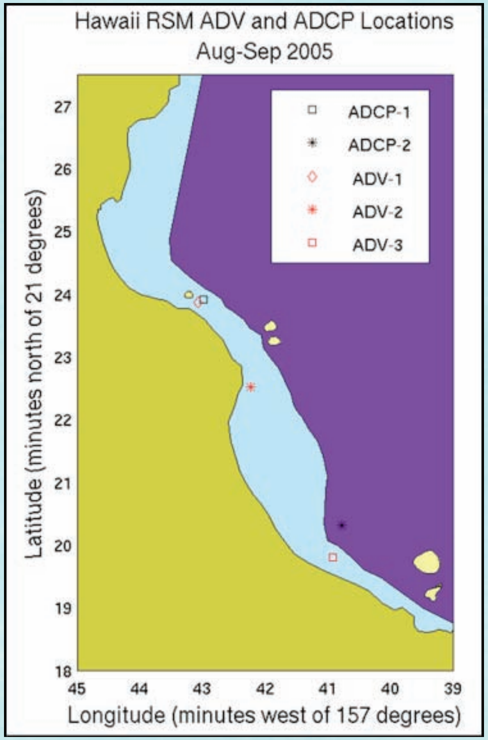

Figure 1. ADCP and ADV locations.

Figure 2. ADCP in frame (left) and close-up of transducer head with biofouling (right).

Figure 3. Hydra ADV in frame (left) and closer view of the biofouled sensor head (right).

mount that was held to the bottom with about 80 pounds of lead weight. These gauges have four acoustic transducers for measuring currents and a pressure sensor, from which horizontal and vertical current profiles were computed at 0.2-meter vertical spacing. These units sampled at 2 kilohertz for directional wave measurements. Each hourly wave burst was approximately 34 minutes long, starting at the top of each hour, and consisted of 4,096 points. There is a 0.44-meter blanking distance from the transducer head, and with a 0.2-meter bin width, this makes the first sample 0.72 meter past the transducer, or about 1.12 meters off the bottom. Current profiles were collected every 10 minutes from a 200-point average.

The three ADV gauges were the Sontek's Hydra model that sample a single point current velocity (U, V, and W) and contained an external pressure sensor. The instrument frame and ADV transducer are shown in Figure 3 (after gauge retrieval). The sample volume for the current measurement is approximately 1 to 2 centimeters in size and about 0.17 meters from the center transducer. This unit uses three beams to determine the three current components.

Four inexpensive current drogues (drifters) were designed and built at the USACE Coastal and Hydraulics Laboratory (CHL) Field Research Facility (FRF) that used Global Positioning System (GPS) tracking and radio telemetry for positioning. They were constructed with off-the-shelf plumbing supplies (PVC pipe, vertical risers, rubber unions, hose clamps), Garmin Geko GPS

Figure 4. GPC current drogue with traditional drifter (grapefruit) and Hawaiian drifter (coconut). Drifter floats just below the surface.

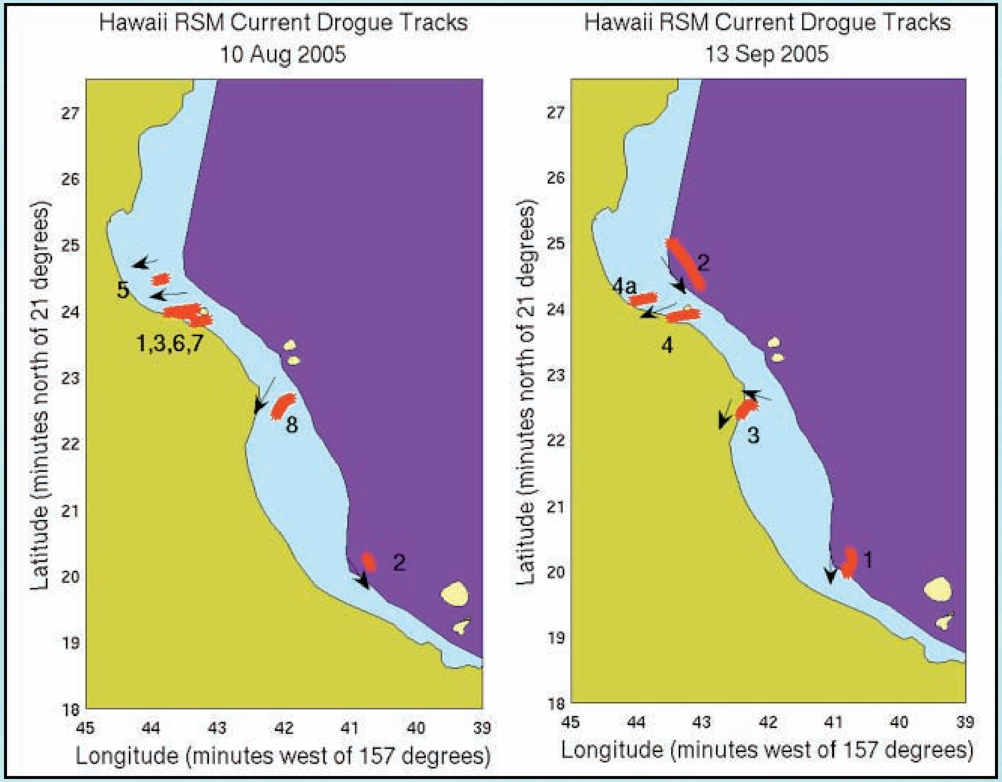

Figure 5. Drogue tracks with track number for 10 August (left) and 13 September (right).

receivers, and MaxStream (model XStream-PKG-R) radio modems (Figure 4). The sails had about a 1-meter cross section. The lower vertical PCV pipe (submerged) contained the modem and batteries, the upper horizontal pipe contained the GPS receiver and radio antennas. A National Electrical Manufactures Association (NEMA) GPS data string was transmitted once per second and the Garmin Fround Control Points (GCP) unit internally recorded positions every 30 seconds. These GPS units are Wide Area Augmentation System

(WAAS) enabled and have a horizontal accuracy of about 3 meters. The radio tracking required line of sight, and it was not possible to simultaneously receive drifters signals in the Kailua and Waimanalo bays.

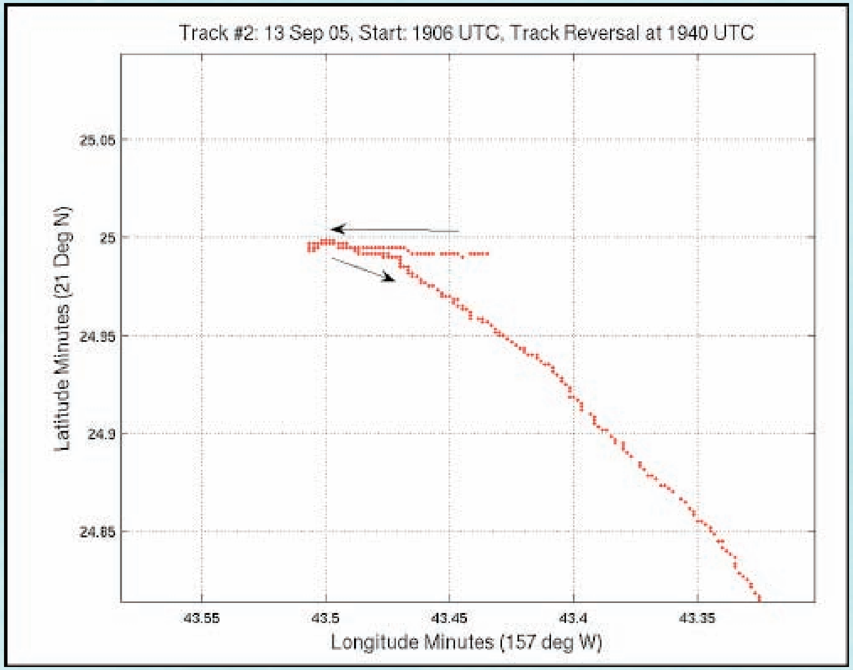

Figure 6. Drouge track reversal on 13 September.

Drogue tracks with track numbers are shown in Figure 5. Some drogues were deployed in the vicinity of the ADV and ADCP gauges for interomparison. An interesting reversal of drogue No. 2 was observed shortly after deployment on 13 Sep (Figure 6), starting off on a nearly due west tract and then turning back to a southeast trajectory.

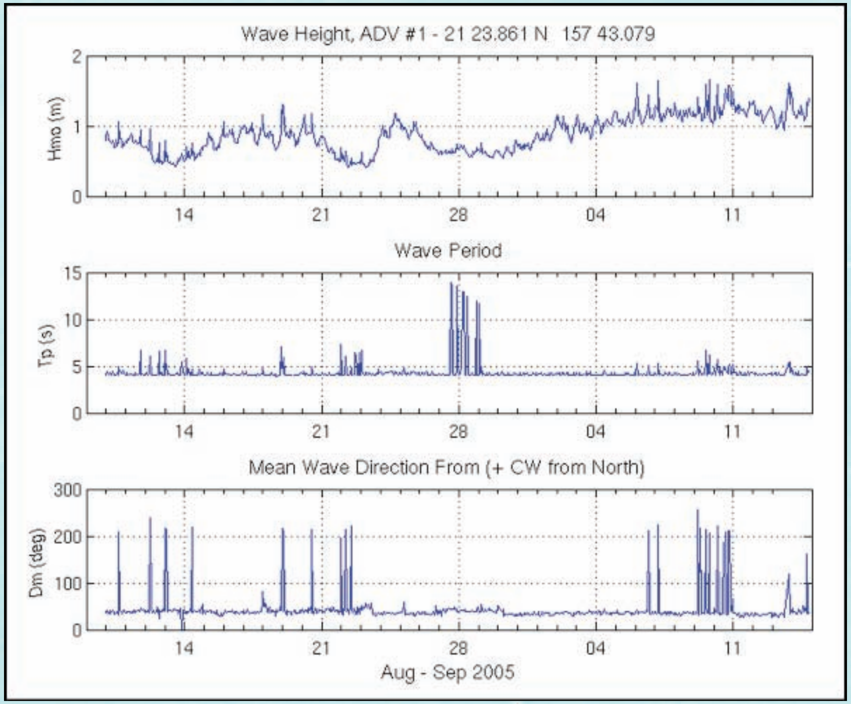

Figure 7. Wave height, period, and direction for ADCP No. 1.

Figure 7 is a plot wave height (Hmo), peak period (Tp), and mean direction (Dm) for ADV No. 1. Figure 8 compares Hmo for the three ADVs and shows ADV No. 3 as having the smallest wave heights. Current directions for ADV No. 2 appear to be mainly north or south which may be due to placing the gauge between coral heads that restricts flows to those directions.

The field data is being utilized to calibrate and verify the results of ongoing wave transformation and water circulation modeling. Bathymetric data used in the generation of model grids were derived from various sources. National

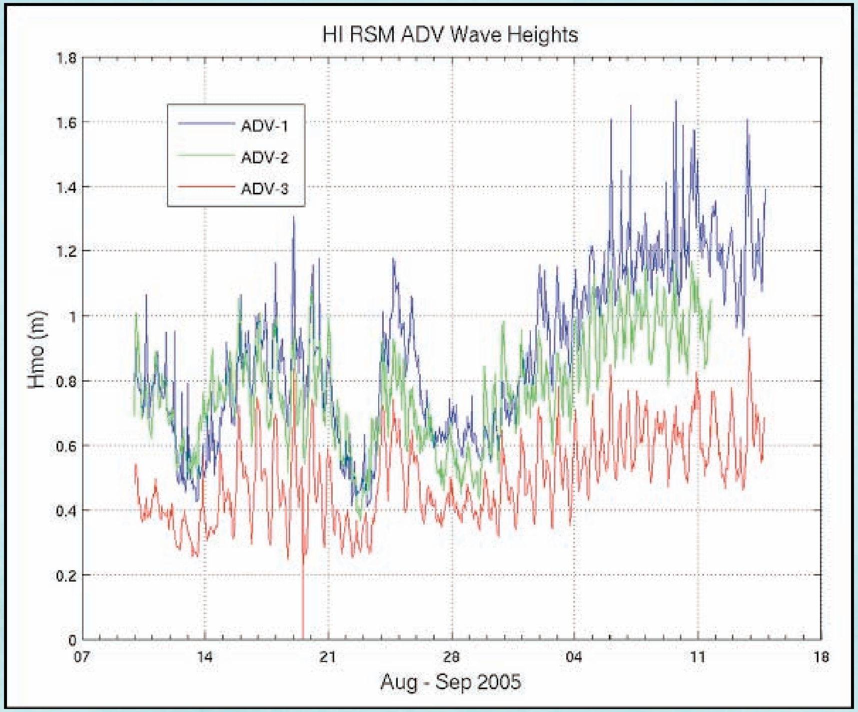

Figure 8. Wave height (Hmo) comparison of the three ADVs.

Geophysical Data Center data sets including ETOPO2 and GEODAS were used in the deep ocean while National Oceanic and Atmospheric Administration (NOAA) digital nautical charts and SHOAL were used for intermediate and nearshore waters, respectively. Grid element size for the circulation model ranged from 75 miles to 80 feet. Bathymetric data were interpolated onto the circulation model grid and hand-edited to ensure accuracy.

Tidal constituents from an established database were used to force the model boundary water levels as well as hindcast winds procured from Ocean Weather, Inc. Tide levels generated by the model compared favorably to NOAA tide gauge data from Kaneohe (bamboo god) Bay and Honolulu (calm bay) Harbor. Wave transformation modeling was conducted over a grid incorporating the SEO region as well as additional area both longshore and makai (oceanward). A directional wave gauge (University of Hawaii/Coastal Data Information Program (CDIP) gauge 098) has been operational at the boundary of the grid from August 2000 to the present and has provided valuable boundary conditions for use in model calibration/verification with nearshore field gauge data acquired as

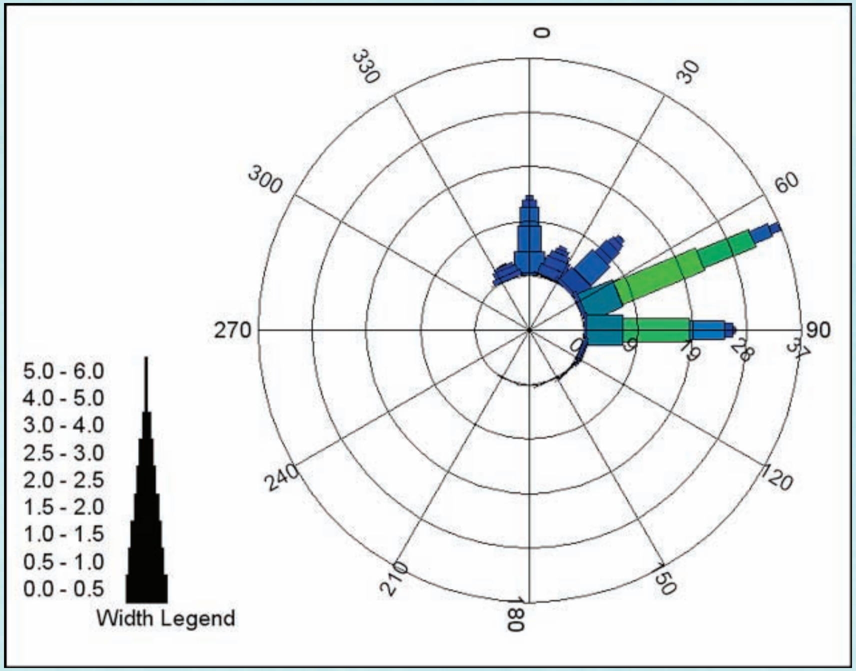

Figure 9. Wave rose for UH/CDIP bouy in RSM demo area.

previously described. As shown in Figure 9, waves recorded by the University of Hawaii gauge were generally from the northeast quadrant and ranged in height from 0.5 to 1.5 meters. Wave periods were on the order of 6 to 16 seconds. Currently, the wave transformation and water circulation modeling is being refined based upon comparison to the field data. Once calibrated, the models will be used to hindcast the wave/wind/tide induced water circulation within the SEO/RSM study area for the year 2004.

The historical shoreline change analysis being conducted for SEO/RSM by the University of Hawaii consists of determining the rate of shoreline change at 20-meter intervals alongshore over the period of early 20th century to 2005. NOAA "T" sheets dating from the early 20th century are being orthorectified using modern GPS ground control and used in comparison with four to eight orthorectified aerial photographs from the post-World War II era to determine a long-term rate of shoreline change. Reweighted weighted least median of squares linear regression technique is being used to determine the long-term trend of historical change. This technique eliminates outlier points from the linear regression and combines measurement and positional uncertainties with regression uncertainties in calculating the standard deviation of the trend.

New aerial photographs from 2005 with a scale of 1:8400 digitally scanned at 10 microns will be acquired for the study. These aerials will cover a coastal strip approximately 800 to 1,000 meters wide centered on the shoreline. Stereo-photogrammetry using orthorectified pairs of photos, with GPS ground control, will be used to create coastal digital terrain models (DTMs). These DTMs will be digitally combined with offshore SHOALS data (where such data exist) to create a seamless topographic/bathymetric DEM for the region. Historical photography and "T" sheets will be orthorectified using the 2005 DEM so that all derived shoreline data are based on orthorectified positions, thus minimizing positional errors. Root mean square positional error of final orthorectified photographs is typically about 1 to 2 meters. Using topographic field profiles to measure beach and dune volume shoreline change rates can be converted to rates of sand volume change over time. Along with historical shoreline change data presented at a 20-meter interval along the entire region a sediment budget for the period of study (approximately 80 years) will be produced.

Sediment Trend Analysis (STA) is a technique that derives patterns of net sediment transport from relative changes in grain-size distributions of aquatic sediments. STA also determines the dynamic behavior or stability (i.e., erosion, dynamic equilibrium, accretion or deposition) of the sediments. Sediment Trend Analysis is used to derive the following information:

- Grain size characteristics of surficial sediment encompassing the entire area of study
- Sediment sources and sinks
- Zones of influence of sediment sources

- Sediment transport pathways
- Sediment stability (i.e., erosion, accretion, dynamic equilibrium, etc.)
- Links between intertidal or beach areas and offshore sediments

For the SEO/RSM study, STA will be utilized as another means to identify sediment pathways in the vicinity of Wailea Point. Sediment sampling is to consist of acquisition of 250 grab samples by the University of Hawaii, analysis of the sediment samples by the CHL and the ultimate use of STA methodology by the University of Hawaii to qualitatively describe how sand moves around and offshore of Wailea Point.

Comparison and correlation of the field data, numerical model results, historical shoreline change analysis, and STA will unlock the mystery of sediment transport within the Wailea Point subregion of the SO/RSM study area. Given an accurate understanding of sediment transport and coastal processes in and around Wailea Point, stakeholders and decision-makers will be able to forge realistic goals in the management of beach resources along the Lanikai and Bellows Air Force Stations shorelines. With a regional sediment management plan in hand, the remaining question will be “Loa’a One? (Got Sand?)”.

Loa’a One? (Got Sand?)

Improved Characterization and Estimates of Sediment Sources, Pathways, and Sinks under the System-Wide Water Resources Program (SWWRP)

By Lisa C. Hubbard and David Biedenharn, Coastal and Hydroulics Laboratory, ERDC, Maureen Corcoran, Geotechnical and Structures Laboratory, ERDC, Terry Sobecki, Cold Regions Research and Engineering Laboratory, ERDC, and David Soballe, Environmental Laboratory, ERDC.

As water resources projects increase in complexity, there is a growing emphasis on the ability to implement effective regional sediment management (RSM). A common goal of many RSM projects is the reduction of sediment loading from the watershed. To accomplish this rehabilitation, features such as grade control, bank stabilization, drop pipes, and land treatments are used. While these features are often implemented with the stated purpose of reducing sediment yields to downstream reservoirs, flood-control channels, or wetlands, the spatial and temporal impacts of these features with respect to downstream sediment loads are far from straightforward, and often result in unanticipated morphologic adjustments and degradation of riverine habitats and ecosystems.

Effective regional sediment management lies in identifying the sediment sources and sediment sinks and understanding the processes responsible for transferring sediment along the pathways that link sediment sources and sinks at the reach and watershed scales. Typical sources include bank caving, gully advancement, upland areas experiencing sheet and rill erosion and landslides, among others. Therefore, the ability to make reasonable estimates of sediment loadings from these sources and establish the transport processes though the system is a key component in the understanding and modeling of channel systems.


Red River, Louisiana, bank caving source

Although the proper identification of these processes and estimation of sediment loadings from sources is critical to effective numerical modeling studies and regional sediment management, the understanding of these processes is limited. For this reason, it is necessary to study these processes to fill this knowledge gap and develop protocols for establishing supply rates from sediment sources, and to establish the spatial and temporal aspects of sediment movement with respect to sources, pathways, and sinks.

Sediment transport of nutrients is also a major process in most watersheds. It is important because water column nutrient status is the primary factor that impacts water quality throughout many U.S. Army Corps of Engineers water resources projects. Incorporating knowledge of nutrient sources, transport pathways and sinks to sediment process studies would be an important step in providing data input for nutrient modeling studies.

The objectives of this research are to: (a) develop methods for making reasonable estimates of watershed-scale sediment delivery to channel systems from bank caving, washoff from overland sources and other sediment sources; (b) develop improved understanding and methodology for establishing how these sediments are transported through channel systems from their source through pathways to their ultimate sinks; and (c) associate existing information on regional nutrient status at the watershed-scale with sediment sources, pathways and sinks processes. These objectives have been broken down into five areas. Three sediment sources are being examined: banks under the direction of Lisa Hubbard, Coastal and Hydraylics Laboratory (CHL), gullies under the direction of Maureen Corcoran, Getotechnical and Structures Laboratory (GSL), and overland flow under the direction of Terry Sobecki,Cold Regions Research and Engineering Laboratory (CRREL), and David Soballe, Environmental Laboratory (EL). The pathways study is under the direction of Maureen Corcoran. All tasks


Caney Creek, Mississippi, channel degradation

concerned with sediment sources and pathways are in their initial phases and funded through FY 08. The nutrient study is also in its initial phase and funding is planned for a one-year effort (FY06).

PRODUCTS

While extensive information has been written about sediment transport, there is much less in the literature concerning sediment transfer, and there is surprisingly little published guidance on how sediment sources, pathways, and sinks can be identified and characterized within the context of project-related studies. Although detailed knowledge of the processes and mechanics of sediment transport informs sediment transfer studies, the complexity and large scale of watershed sedi-

ment dynamics preclude analysis using an approach that starts with the movement of individual grains. What is needed is a broader consideration of the sediment transfer system that supports higher-level treatment by reproducing the main functions and responses without attempting detailed replication of sediment transport processes. This need has been addressed within this work unit by the development of the wash load and bed-material load concept. The wash load and bed-material load concept was developed to quantify the transfer of sediment from its source, through its pathways, to its ultimate sinks thereby providing a reliable analytical foundation for effective regional sediment management.

There is no universally accepted definition of wash load, yet despite this, the wider concept that sediment in transport that is finer than that making up the bed of the channel behaves differently and plays a different role in the sediment transfer system is widely perceived to have merit and has often proven useful in river-engineering studies (Einstein 1950).[1] In this respect, there are three aspects within the wash load and bed-material load concept that are relevant from a practical regional sediment management perspective. First, because wash load is fine relative to the bed-material load, the stream does not need to expend significant amounts of energy in transporting it through the fluvial system. Second, the quantity of wash load carried by a stream is limited not by the stream's sediment transport capacity, but by the available supply. Third, the movement of wash load is relatively rapid compared to that of the bed-material load.

It must also be recognized that spatial variation in the wash load and bed-material load threshold grain size is inherent to most fluvial systems. Generally, the upper bound grain size for the wash load becomes finer in the downstream direction due to downstream fining of the bed material. A typical example of this trend is shown in Figure 1 for the Mississippi River. On the Mississippi River, the bed material D10 values decrease from about 0.25 mm in the New Madrid to Memphis, Tennessee, reach to about 0.063 mm below Baton Rouge, Louisiana.

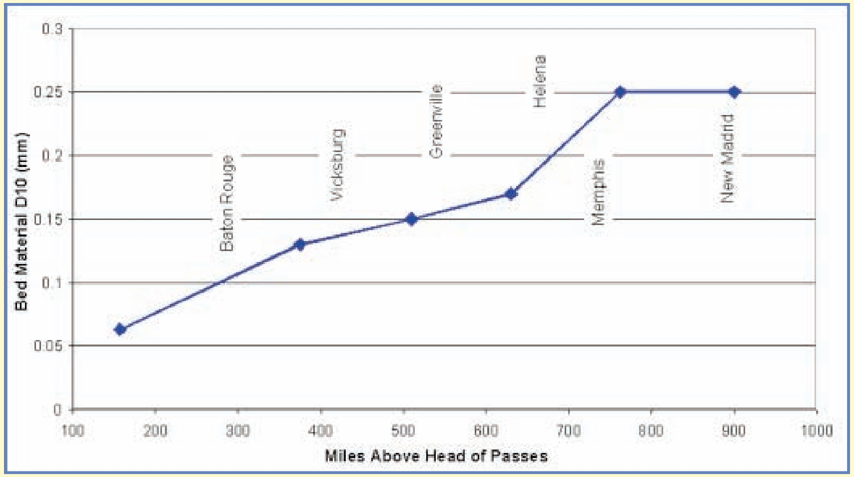

Figure 1. Bed material D10 along the Lower Mississippi River (adapted from Nordin and Queen 1989[1]).

[1] Einstein, H. A. 1950. *The bed-load function for sediment transportation in open-channel flows.* USDA Soil Conservation Service, Technical Bulletin No. 1026.

[1] Nordin, C. F., and B. S. Queen. 1989. *Particle size distributions at bed sediments along the thalweg of the Mississippi River, Cairo, Illinois, to Head of Passes*. Potamology Program (P-1) Report 7, USACE Lower Mississippi Valley Division.

Spatial changes in the upper limit of wash-load size such as these have important implications for sediment dynamics in the fluvial system. For example, where the threshold size decreases in the downstream direction, as in this case, then the coarser fraction of wash load entering a reach from upstream must be reclassified as bed-material load in that reach. As a result, the behavior of this fraction of the total load switches from that characteristic of wash load to that of bed-material load, with consequential impacts on local sediment dynamics and morphological responses.

Temporal changes in the wash-load threshold grain size may also occur, but are more difficult to generalize. For example, the particle size distribution of the bed in some streams varies seasonally. In such cases, care would have to be taken to match the sampling strategy used to establish the D10 for the bed to the purpose of the study. For instance, it might be necessary to investigate seasonal variability in sediment impacts or to characterize long-term sediment dynamics that are independent of seasonal fluctuations.

Application of the wash load and bed-material load concept to regional sediment management can better be illustrated using an example based on the D10 plot in Figure 1. For this example, consider a sediment source from a streambank erosion site at River Mile 750 near Memphis, Tennessee, where the bank comprises material finer than 0.25 mm. Since the wash load - bed-material load threshold in this reach is about 0.25 mm; all of the material eroded from the bank will be supplied to the river at this location as wash load. Consequently, stabilization of this bank would have a minimal morphological impact in this reach because the source material is all wash load within the reach, and not contributing significantly to the morphology of the reach. However, downstream near Vicksburg, Mississippi (River Mile 435), where the bed-material-wash load threshold has decreased to about 0.14 mm, the channel would realize a reduction in the supply of bed material in the range of 0.25 mm to 0.14 mm. Thus, the Vicksburg reach would realize an almost immediate reduction in bed-material supply, and some sort of morphologic response would be expected. For instance, if the Vicksburg reach was experiencing aggradation, then the reduction in the bed material supply might lessen the aggradational trend. However, if the Vicksburg reach was in dynamic equilibrium, then the reduction in bed material supply could potentially shift the


Crowder Creek, Mississippi, bed, banks and gullies

channel to degradation. Now consider what would happen if the bank material source near Memphis was composed completely of material greater than 0.25 mm. In this instance, stabilization of the bank could have a more significant morphologic impact in the Memphis reach since a bed-material source has been removed. However, the short-term impacts to the downstream reaches would be minimal. In fact, there could be a considerable time lag before the downstream reaches experience any sediment reduction, because these reductions would be purely a function of the morphologic adjustments in the Memphis reach. Obviously, these are hypothetical examples, and the actual response would depend upon the relative magnitude of the reduction in sediment supply and the morphologic characteristics of the river. These hypothetical examples do, however, illustrate how the concept could be used to assess the potential impacts of sediment management activities.

The sediment impact analysis methodology presented here provides a conceptual basis for developing, designing, and optimizing erosion control and channel-improvement plans. In practice, predicting the magnitude of sediment impacts and the nature of morphological responses to the changes in flow and sediment inputs would require development of a quantitative sediment budget for the channel system that includes and accounts for all the significant sediment sources in the watershed. To this end, the Sediment Impact Assessment Model (SIAM) was developed. SIAM incorporates the wash load and bed-material load concept discussed herein, and enables rapid assessment of the impacts of changes in flow and sediment


Long Creek, Mississippi, gully source


North Mississippi, overland flow source

input throughout the channel system. The incorporation of SIAM into the USACE Hydraulic Engineering Center - River Analysis System (HEC-RAS) will be available for beta application in September 2006.

SUMMARY

The five work units undertaking the task of increasing the understanding and developing methodologies for estimating volumes of sediment by grain size, from different sediment sources and linking the amounts of nutrients input to the system are ongoing. The results will be forthcoming by the end of FY08. The outcome will be improved estimation of the required sediment source data input for SIAM, Gridded Surface Subsurface Hydrologic Analysis (GSSHA), ADaptive Hydrology Hydraulics (ADH), and HEC-RAS (SEDIMENT). This research will also aid in validation, calibration and interpretation of these models and provide improved methods for assessing the geomorphic stability of channel systems.

New Program Manager

Jeffrey P. Waters has assumed the position of Program Manager for the RSM Demonstration Program. He is a research physical scientist in the Coastal and Hydraulics Laboratory's Coastal Engineering Branch.

A native of Saco, Maine, Waters spent the past four years as a coastal geologist with the USACE Galveston District. He received a B.S. in Geology from the University of Maine, M.S. in Geology from Northern Arizona University, and a Ph.D. from the University of New Orleans.

He can be contacted at: U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180; Voice: (601) 634-2020; FAX: (601) 634-3080; e-mail, Jeffrey.P.Waters@erdc.usace.army.mil .

2006

29-31 Aug - Managing Sediments in the Watershed: Bringing Dredged Material and Watershed Managers Together, National Dredging Team Conference, Portland, OR, will be held at the Doubletree Hotel. The annual RSM Workshop will be held in conjunction with this conference. For information contact: jeffrey.p.waters@erdc.usace.army.mil.

3-8 Sep - 30th International Conference on Coastal Engineeering (ICCE), San Diego, CA, will be held at the Manchester Brand Hyatt San Diego. More information is available at http://www.icce2006.com/.

9-13 Dec - 3rd National Conference on Coastal and Estaurine Habitat Restoration - Restore America's Estuaries (RAE), New Orleans, LA. The conference will emphasize our success and the challenges ahead in strengthening the national commitment, to restoration. More information is available at www.estuaries.org/?id=4.

A comprehensive listing of water related conferences and workshops can be found at: http://chl.erdc.usace.army.mil/CHL.aspx?p=s&a=Conferences!0.

POCs

Jeffrey P. Waters has assumed the position of Program Manager for the RSM Demonstration Program. He can be contacted at U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, 3909 Halls Ferry RD, Vicksburg, MS, 39180; Voice: (601) 634-2020; FAX: (601) 634-3080, e-mail, Jeffrey.P.Walters@erdc.usace.army.mil

Bill K. Mullen is the point of contact for the RSM Newsletter and other technology transfer involving the program. He can be contacted at U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, 3909 Halls Ferry RD, Vicksburg, MS, 39180; Voice: (601) 634-2061; e-mail, Bill.K.Mullen@erdc.usace.army.mil

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Southeast O’ahu Regional Sediment Management (SEO/RSM) study area